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☞ An asterisk (*) denotes an illustrated article

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THE NEW YEAR.

The year just closed has been an eventful one to this country. It has witnessed the completion of the first century of our national existence, and the gathering of all nations within our borders to see the results of our national growth, industry and ingenuity.

It is hardly our province to speak of the great results accomplished by the country at large, but if we simply confine our review to our own industry, that of gas manufacture, and the branches of science more intimately connected with it, we may find much to be satisfied with and much yet unexplained which will furnish material for research and investigations in the future. At the beginning of the century the manufacture of gas was unknown, to-day there is something like 70 or 80 millions of dollars invested in its immediate manufacture in this country, to say nothing of the many other millions invested in the manufacture of the various apparatus and supplies which the business demands. At the beginning very little attempt was made at purification, but the necessities of its use has created, so to speak, a class of scientific men who have devoted years of careful study to the chemistry ot gas making, until to-day the impurities of coal gas are kept within the narrowest limits. At first it was conducted in a kind of "hap hazard" method that led to very uncertain results. Now, the prudent, competent gas manager can predict his results with almost absolute certainty. This is not the result of chance, but of careful study and constant experiment, which has enabled those who have devoted their time to the matter to determine the fixed laws that govern the whole process from the beginning to the end.

It is only by carefully studying these results, and becoming familiar with these laws that a gas works can be successfully managed to-day. The constant tendency is to a reduction of price. The demand for this reduction is constant and urgent, and it can be met only by a more scientific proceedure in the conduct of the business by which every element of unnecessary cost shall be eliminated, and every means for improving the quality be made available.

Within the past few years Associations have been formed, both in this country and in Europe, for the purpose of mutual instruction and improvement, and the various matters that have been discussed by these various meetings have been of great benefit to the profession in general. But there remains much to be done. Many and great changes are likely to occur in the future, as in the past, and he who would not be left behind in the race must keep himself posted with passing events, and must, above all, make himself familiar with the fundamental principles which underlie the business, in order that he may be able to discriminate between change and progress. For instance when one hears statements of results which, when figured out on a legitimate basis, show that more pounds of gas are made from a ton of coal than there are pounds in the ton of coal itself, it is evident that mistakes have been made somewhere. Conclusions are not to be jumped at. Sound reasoning, from correct premises, is much more satisfactory in the end.

The experience of others may easily be made available and brought to our aid—and this is the object of this Journal. In the year now commencing we would urgently ask all interested in the advancement of the science of gas-making, to make our columns a medium of communication between themselves, and that they would, through them, enter more largely into the discussion of the various points that are constantly arising in daily practice. We wish the gas makers of the country to take a personal interest in their Journal, and to contribute to its usefulness and its success. There are many "little things" occuring constantly that are but fractional illustrations of general principles that are not sufficiently familiar to many, and which, when stated, would be the means of affording instruction of the very best kind. At the close of this—the first year of our connection with the Journal—we would acknowledge the many courtesies extended, and the many obligations we are under, for the efforts of some in making the paper a good one: and we sincerely trust that, while these efforts are continued, many others may be ready and willing to contribute their *mite* or their *might* to make this Journal creditable to all.

In closing, we would wish our readers a "Happy New Year," and trust that success and prosperity may attend them, not only through this, but through all succeeding years.

CHEMISTRY IN AMERICA.

During the last year there was formed in New York City a society of chemists, under the title of "The American Chemical Society." Dr. John W. Draper delivered the inaugural address before the society, on Nov. 16th, which is given in full in the *Popular Science Monthly* for January. The address was not only an able one, but, in

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some of its parts, most beautiful. No synopsis would do it justice, but we give a portion of the lecture, which speaks more particularly of what has been done in our own land in the development of science.

"Of our own special science, chemistry, it may truly be affirmed that nowhere are its most advanced ideas, its new conceptions, better understood or more eagerly received. But how useless would it be for me to attempt a description in these few moments of what Prof. Silliman, in the work to which I havs already referred, found that he could not include on more than 100 closely-printed pages, though he proposed merely to give the names of American chemists and the titles of their works! It would be equally useless and indeed an invidious task to offer a selection; but this may be said, that among the more prominent memoirs there are many not inferior to the foremost that the chemical literature of Europe can present. How unsatisfactory, then, is this brief statement I have made of what might be justly claimed for American science! Had it been ten times as long, and far more forcibly offered, it would still have fallen short of completeness. I still should have been open to the accusation of not having done justice to the subject.

"Have those who gloat over the shortcomings of American science ever examined the Coast Survey reports, those of the Naval Observatory, the Smithsonian contributions, those of the American Association for the Advancement of Science, the proceedings of the American Academy of Arts and Science, those of the American Philosophical Society, the Lyceum of Natural History, and our leading scientific periodicals? Have they ever looked at the numerous reports published by the authority of Congress on geographical, geological, engineering, and other subjects—reports often in imposing quartos magnificently illustrated.

"Not without interest may we explore the origin of the depreciation of which we thus complain. In other countries it is commonly the case that each claims for itself all that it can, and often more than is its due. Each labors to bring its conspicuous men and its public acts into the most favorable point of view; each goes upon the maxim that a man is usually valued at the value he puts upon himself. But how is it with us? Can any impartial person read without pain the characters we so often attribute to our most illustrious citizens in political and. what is worse, in social life? Can we complain if strangers accept us at our own depreciation, whether of men or things?

"We need not go far to detect the origin of all this—it is in our political condition. Here wealth, power, preferment—preferment even to the highest position of the nation—are seemingly within the reach of all, and in the internecine struggle that takes place every man is occupied in pushing some other man into the background.

* * * * * * * *

"There are among us some persons who depreciate science merely through illiterate arrogance; there are some who, incited by superficiality, dislike it; there are some who regard it with an evil eye, because they think it is undermining the placid tranquility they find in life-long cherished opinions. There are some who hate it because they find that it is in conflict with their interests.

"But let us who are the servants of Science, who have dedicated ourselves to her, take courage. Day by day the number of those who hold her in disfavor is dimishing. We can disregard their misrepresentations and maledictions. Mankind has made the great discovery that she is the long-hoped-for civilized agent of the world. Let us continue our labor unobtrusively, conscious of the integrity of our motives, conscious of the portentous change which is taking place in the thought of the world, conscious of the irresistible power which is behind us! Let us not return railing for railing, but, above all, let us deliver unflinchingly to others the truths that Nature has delivered to us!

PUBLIC LAMPS IN NEW YORK CITY.

The following are the bids for lighting the public lamps, and making such repairs as are mentioned, for three months, from January 1st, 1877.

The bids were opened at the City Hall, at 12 o'clock, on Dec. 28th.

Company.	Gas, Lighting, cleaning, etc.	Lamp-Post straightened.	Column releaded.	Column refitted.	Lamp post removed.	Lamp post reset.	New Lamp fitted up.
Manhattan.....	$7.50	1 50	1 50	3 50	3 50	10	10
Metropolitan..	9.00	2	2	3	3	8	8
New York.....	7.50	1 50	1 50	3 50	3 50	10	10
Harlem.....	10.57	3	3	4	4	10	10
Mutual.....	9.00	1 50	1 50	3 50	3 50	10	10

Tar as Fuel.

[A Paper read before the Society of Gas-Lighting.]

In the present advanced stages of chemical science and art, it may seem barbarous to use, as a fuel, a material that has attracted the careful and prolonged investigations of the most eminent chemists, culminating in the discovery, by Graebe, of alizarine. A discovery regarded as one of the most important of the age, as affecting not only the commercial and agricultural interests of the world, but as being one of the strongest proofs of the truth and importance of the molecular theory of chemistry.

Yet the desire of those whose property is invested in the gas factory is rather to realize than theorize, and, as in certain parts of the country, at times, it pays better to burn the grain than to send it to market, so there are times when it is better to burn our tar than to give it away or to sell it at too low a figure. Indeed, it may be profitable to buy tar, or some other liquid hydrocarbon, in order to be able to sell a large quantity of coke. The use of liquid fuel, especially in heating gas retorts, is comparatively ancient, and its value in practice, as compared with solid fuel, has been quite satisfactorily determined.

The discovery of what was supposed, at one time, to be an inexhaustible supply of petroleum, induced many experiments to determine its efficiency as fuel, especially as regards the production of steam. It was reported, I believe, by a commission in this country, appointed to make an examination, that it was more than twice as efficient, weight for weight, as anthracite coal. In England, in one or more instances, it was represented that one ton of oil was equal to from four to five tons of coal.

Experiments made with petroleum, at Woolwich, in 1866-7, under the superintendence of Mr. Trickett, the engineer-in-chief of the Dockyard, gave, as the highest evaporative effect, 11·63 lbs. of water converted into steam per lb. of oil burnt. The most successful trial with coal oil, and shale oil, gave an evaporative effect of about 18 lbs. of steam produced per pound of oil burnt. Some of the statements, in reference to the efficiency of oil as fuel, were so exaggerated that a question arose at that time in reference to the possibility of a fuel generating a higher calorific value than it should theoretically. This question was discussed before the United Service Institution by so eminent an authority as the late Professor W. J. M. Rankine. In relation to this discussion Benjamin H. Paul, Esq., in his paper on Liquid Fuel, says:

"The very lucid and exhaustive exposition, given by Professor Rankine, of the conditions which determine the theoretical evaporative power of fuel, ought to have been sufficient to prevent any misconception as to the possibility that the evaporative effects realized with fuel can exceed, or even equal, the extreme calculated power it is capable of producing."

The following experiments made by Dulong, Rumford, Lavoisier, and others, show the units of heat, per pound of fuel, generated by various liquid hydrocarbons—

Colza oil	gave	16753	units of heat.
Olive oil	gave	20153	" "
Oil of turpentine	"	19505	" "

Carbon burned to carbonic acid gives 12906 units. In reference to the efficiency of tar as a fuel, it is stated, in the preface to Ure's Dictionary, that—

Each gallon of tar, weighing from 10½ to 11 pounds, is found to have a calorific power equal to half a bushel of coke, weighing from 21 to 23 pounds. There is not a gas engineer in Great Britain ignorant of this important fact, nor the secretary of a gas works, who, with coke at 4d. per bushel, estimates coal tar as fuel at less than 5½d. per gallon, and we happen to have now before us a series of actual workings extending over very long periods of time since the year 1831, and made by the engineer of the largest gas works in the world, for the express purpose of ascertaining the practical details connected with the relative economy of coal tar, coal, and coke, and from which we have deduced the following, as the average value of these combustibles expressed in pounds of coal carbonized, or distilled, by the same weight of each.

Tar	equal	5 lbs
Newcastle coal	"	4½ "
Coke from Newcastle coal	"	3¾ "

The revenue from our tar having greatly fallen off, about three years ago, we endeavored to utilize it as a fuel. The system adopted was to introduce the tar, as finely divided as possible, into the furnace, or in the form of spray by means of superheated steam. It is not the object of this paper to explain this, or any of the many other methods of using this fuel; as this would, in itself, require a long communication, but merely to state the results obtained.

Before giving the absolute work obtained in practice, it may be interesting to show the theoretical calorific power of tar and coke, as the tar, in the former case, shows a remarkable increase in the percentage of efficiency over the coke as compared with their theoretical values.

Calorific Power of Coke.

A pound of dry coke, from the usual mixture of our standard cannel and caking coals, would contain not far from 85 per cent. of carbon; therefore on pound of coke should give—

$$\cdot 85 \times 12906 = 10970 \text{ units of heat.}$$

To obtain the theoretical calorific power of tar, it is necessary to find its chemical composition. This is a matter fraught with some difficulty, and I have obtained only an approximation.

Roscoe gives the following as the average percentage of the products obtained from 100 tons of coal tar:

	1	2
Naphtha	3·0	2·0
Light oils and carbolic acid	1·5	0·8
Heavy oils, naphthaline, anthracene	35·0	25·0
Pitch	50·0	60·0
Water and loss	10·5	12·2
Total	100	100

From the small amount of naphtha and light oils, and the large amount of pitch in No. 2, as

compared with No. 1, it is probable that the latter is the product of coal distilled at a lower temperature. The composition of tar is made up from the following statement, prepared for me by the assistant chemist of the largest tar refining works in this country.

Composition of Coal Tar.

Estimated quantities of the different products with their percentages of chemical composition :

Benzole	1·5	C920, H80
Naphtha	27·	C905, [H95, estimated]
Carbolic acid	5·	C766, H64, O170
Cresylic "	4·	C778, H74, OI48
Basic oils	1·	C775, H55 [N170, estimated]
Naphthaline	22·	C938, H62
Phenanthrene	3·	C944, H56
Anthracene	1·	C944, H56
Chrysene / Pyrene	0·5	C948, H52
Pitch, coke	35·	C960, H10, S5, Ash, 25
	160·0	

Approximate Composition.

Coal Tar.

Carbon	92·0
Hydrogen	5·3
Oxygen	1·4
Nitrogen	0·3
Sulphur	0·2
Ash	0·8
	100·0

The water always present in coal tar, as found in the tar wells at the gas works, would make the approximate composition about as follows :

Approximate Composition of Coal Tar. when Taken from the Tar Well.

Carbon	82·88
Hydrogen	4·77
Oxygen	1·27
Nitrogen	·27
Sulphur	·18
Ash	·72
Water	9·91
	100·00

The calorific power of such a combustible would be as follows :

(a) Carbon $82{\cdot}88 \times 12906 = 10696$ units of heat.

(b) Hydrogen ; here the presence of free oxygen in the tar, requiring one-eighth part of its weight of hydrogen to form water, will reduce the calorific power of the hydrogen. The O will require $1{\cdot}27 \div 8 = {\cdot}158$H, and $4{\cdot}77 - {\cdot}158 = 4{\cdot}61$ H in excess to develop its heat. Therefore, hydrogen $= 62535 \times .461 = 2883$ units of heat. The nitrogen and sulphur, being small in amount, will not be considered.

An allowance is to be made for the evaporation f the water, which is taken at a temperature ofo 62 deg. F. For its evaporation will be required

$$(1178 - 62) \times {\cdot}0991 = 111 \text{ units of heat.}$$

The calorific power power of coal tar is, therefore, equal to—

$$10696 + 2883 - 111 = 13468 \text{ units of heat.}$$

A pound of tar gives, therefore, theoretically, 2498 more units of heat than a pound of coke, or, as a theoretical fuel, it stands 22 and 7-10 per cent. higher. In practice the comparison, either by weight or volume, is still more favorable to the tar.

As stated above, in the quotation from Dr Ure, coal tar is fully 100 per cent. more efficient as a fuel, weight for weight, than coke. In our use of tar a trial was made, running over 120 days, in order to determine the comparative value of the two fuels, with the following result : That one bushel of coke and 1·65 gallons of tar would carbonize equal quantities of coal—or, that 1·65 gallons tar (s. g., 1020) weighing 14·02 pounds, would carbonize as much as one bushel of coke weighing 36·4 lbs.

This would show the tar to be 159 per cent. more efficient, weight for weight, than coke.

A more satisfactory statement to a manufacturer will be the following, in which the figures are made from the working, extending over a period of 32 months, during which not only has nearly all the tar made been used as fuel, but a large quantity of dead oil has been burned in addition. Of course, during this longer period, the inevitable carelessness and waste of the workman will manifest itself.

The dead oil, containing a smaller quantity of water than the tar, is theoretically, a more efficient fuel than tar ; but no allowance is made for this, it is taken gallon for gallon with the tar.

The comparative value of the solid and liquid fuels, is obtained as follows ;

A. Each ton of coal carbonized is assumed to produce 12 U. S. gallons of tar.

B. To A are added the gallons of dead oil purchased and the gallons of tar on hand at beginning.

C. From B are deducted the gallons of tar sold, or used, and gallons on hand at time of statement.

D. The actual sales of coke, in bushels, for the 32 months, are taken.

E. From these sales (D) are deducted the sales per ton, upon the basis of the coke sales per ton, during the three years previous to the use of tar. It is assumed that the coal carbonized during the 32 months, no tar being used, would have produced equal sales of coke per ton during the 3 years.

F. The difference, in bushels, between D and E is taken to represent the value, in bushels, of the liquid fuel.

The results show that, in carbonizing coal,

1 bush. of coke is equal to 1·91 gals. of tar, or,

1 lb. of tar is equal to 2·20 lbs. of coke.

The following are some, and, probably, the principal reasons for the superior efficiency of tar fuel :

1. The combinations of combustion are more perfect.

2. The waste from incomplete combustion is less.

3. The infrequent firing prevents the cooling of the furnace and settings by blasts of cold air.

4. There is little loss of fuel during clinkering, where with coke the loss is large.

A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas.

[From London "Journal of Gas-gLighting."]

The Referees' instructions

AS TO THE TIMES AND MODE OF TESTING FOR ILLUMINATING POWER.

The testings for illuminating power shall be three in number daily.

The photometers to be used in the testing-stations shall be the improved form of the Bunsen photometer, which have been certified to by the Referees.

The disc in the photometer shall be changed at least once a week.

The chimneys must be cleaned daily, at the commencement of each set of observations.

The candles shall be such as are described in section 25 of the Metropolis Gas Act of 1860—namely, sperm candles of six to the pound, each burning 120 grains an hour.

Two of these candles shall be used together.

The quantity of gas burned in each burner shall be five cubic feet per hour.

The gas in the photometer is to be lighted at least fifteen minutes before the testings begin. The gas shall be kept continuously burning from the beginning to the end of the testings.

Each testing shall include ten observations of the photometer, made at intervals of one minute.

The consumption of the gas is to be carefully adjusted to 5 feet per hour, which is shown by the long hand of the meter and the seconds hand of the clock travelling together continuously for some minutes.

The candles are to be lighted at least ten minutes before beginning each testing, so as to arrive at their normal rate of burning, which is shown when the wick is slightly bent and the tip glowing. The standard rate of consumption for the candles is 150 grains each per hour. Before and after making each set of ten observations of the photometer, the gas examiner shall weigh the candles ; and if the rate of consumption shall been more or less per candle than 120 grains per hour, he shall make (and record in a book to be kept for the purpose) the calculations requisite to neutralize the effects of this difference.

The gas examiner shall, at least once a week, test the meter-clocks by the standard clock in each testing-station.

The gas examiner shall observe and record the temperature of the gas, as shown by the thermometers attached to the meters, and also the height of the barometer. The volumes of the gas operated upon during the testings may be corrected by these data in the following manner (the standard of comparison being, for the barometer, 30 inches ; and for the thermometer, 60 deg.) : Suppose the thermometer stands at 56 deg., and the barometer at 30·5 inches, multiply the quantity of gas consumed by the *tabular number* corresponding to the indications of the barometer and thermometer (as given in the Table, Appendix B),—the product will be the corrected volume of the gas—*i.e.*, the volume the gas would have occupied at the standard temperature and pressure. Thus :

Volume of gas consumed	5 cubic feet
Tabular number for barometer and thermometer	1·025

Then $1{\cdot}025 \times 5 = 5{\cdot}125$, the corrected volume.

The same object may be attained more shortly (*vide infra*) by simply dividing the illuminating power by the tabular number, or in the manner to be presently described in connection with the testings for impurities.

The average of each set of ten observations is to be taken as representing the illuminating power for that testing. And the average of the three testings is to be taken as representing the iluminating power of the gas for the day.

The gas examiner shall record his observations and calculations for illuminating power in the form prescribed in Appendix A.

The calculations for working out the corrections, etc., for the illuminating power of the gas. proceed in the following manner :

Add the observations together, and divide the sum by 10, to get the average ; then, as two candles are used, multiply by 2, to get the illuminating power of the gas if tried against one candle. Then, as the standard rate of consumption of the candles (viz., 120 grains) is to the average number of grains consumed by each per hour, so is the above-obtained number to the actual illuminating power. Finally, make the correction for temperature and pressure, by dividing the illuminating power by the taubular numbe

Cathels Patent Gas Washer.

Early in the history of the manufacture of gas, a washer seems to have been considered an essential part of the apparatus of gas works, and time has proved how well founded was the judgment of the "Fathers of Gas Lighting" in this, as in many other things in the economy of gas making. But the value of such a vessel as a cleaner of crude gas, was evidently better understood, than the best principles on which it should have been constructed; and this may with general accuracy be also said of the several modifications since made in it.

In the arrangement of washers generally, the prevailing idea appears to have been to make the length of the vessel considerably greater than its breadth, and to cause the gas to flow through it lengthwise, the longest contact of the gas, with its liquid contents, and therefore the greatest amount of "wash," being thus presumedly secured. But theoretical expectations and actual results in this case, as often happens in others, have been found to be far from agreeing. The effect produced in the pressure of the gas into a heap at the outlet end, thus seriously impairing the vessel's efficiency, and also increasing the back pressure. The patentee has by repeated tests satisfied himself that in such washers about three-fourths of the length of the vessel is entirely inoperative, and its efficiency to such extent nullified.

Profiting by this experience, the first distinctive principle in the improved washer here brought under notice, is to divide such oblong washer as above referred to, by cross partitions into compartments or sections, each being a complete washer of itself, and together forming one combined washer, the power or efficacy of which is increased as is the number of such compartments.

A second important characteristic of the arrangement is, that instead of these several compartments being on the same level, they are elevated the one above the other, in succession, as shown on the drawings, so that when the charge in the lowest or first one is sufficiently strengthened or saturated, to be drawn off, that of the second one can be emptied therein, the third one into the second, and similarly with the others when there are more than three, the uppermost or last one only requiring a fresh charge.

A third special feature in the improvements consists of the following arrangements for effectually dividing or breaking up the gas:

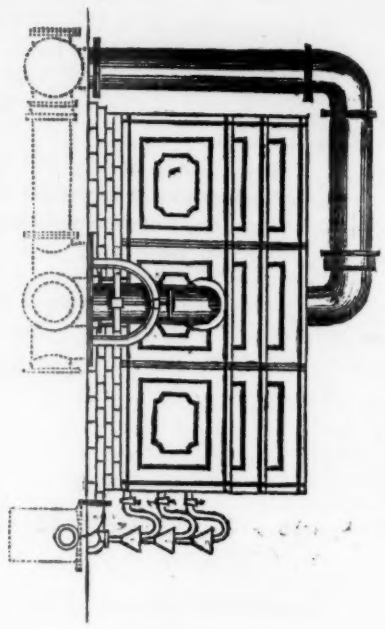
Inside of each compartment, and within a few inches of its front plate, there is a plate or curtain (having its lower edge serrated about four inches deep) which extends the full length of the compartment, and is bolted to the cover and both ends of same, but which only reaches say three-fourths of its depth.

Coinciding with each of these notches or serrations there is an inverted V trough with a flange at each end, fixed at right angles to the curtain, one end being bolted to the curtain and the other end to the back plate of the compartment, both sides of each trough from end to end having also serrations say two inches deep.

The charge in each compartment is to be of such a height, as to at least cover the curtain serrations (and consequently also the troughs leading therefrom), or to any additional height desired. This is effected by increasing the height of the outside self acting overflow pipe, attached to each compartment at one end of the washer, by means of a long screw with which it is provided.

The gasways consist of a slot or opening in the top of each plate between the compartments, extending the whole length of such division plate, but of such a depth only that multiplied into its length, the area shall equal that of the connecting pipes. And the charges in the respective compartments are emptied into each other by means of outside pipes (having stop cocks) at one end of the washer, connecting the compartments as shown.

The gas on entering the first compartment impinges against the curtain and spreads to both ends, blowing the contents of the narrow chamber or space between the front plate and the curtain into the body



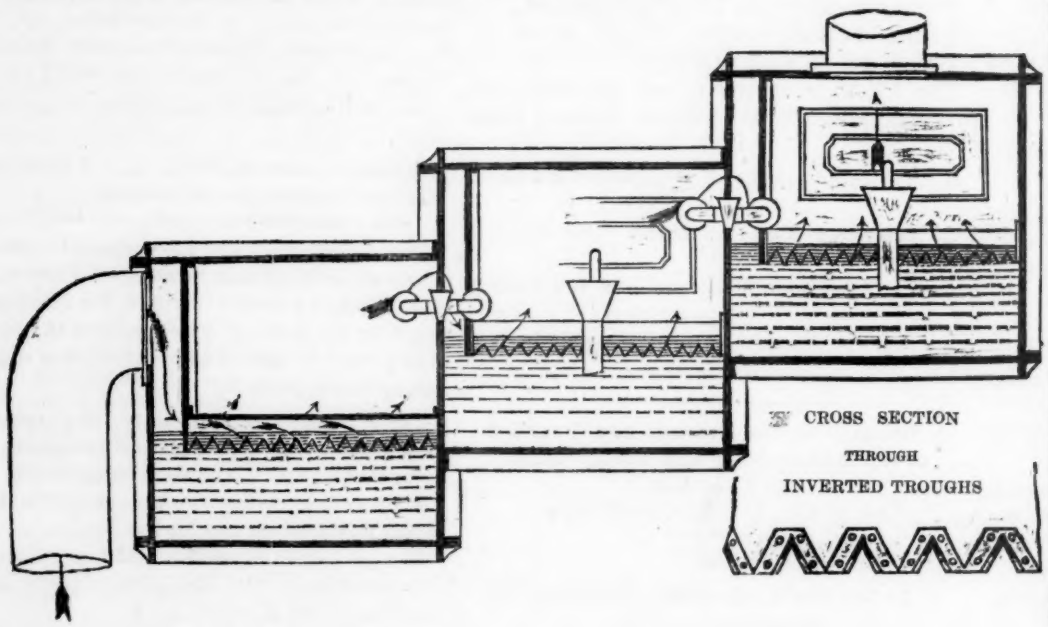
of the compartment behind the latter (but the depth of which is not thereby materially increased owing to the difference in their areas), and in virtue of the series of unequal dips or seals of the curtain serrations, passes through the same in equally divided streams, in which condition of separation it flows into and along the inverted troughs, escaping therefrom by the serrations in their sides, in minute streams or threads, in which attenuated form it bubbles up through the wash liquid.

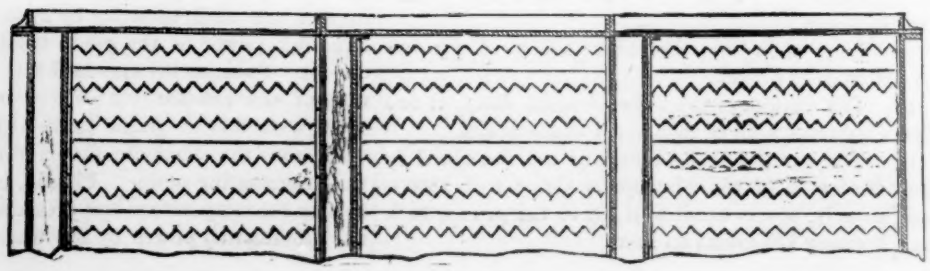
In the subsequent compartments, by reason of the form of their inlet openings, the gas enters in a thin sheet, extending from end to end of each, slides down the faces of their respective curtains, and washes through each in the finely divided condition hereinbefore described.

It will be obvious that any one or more of the compartments may be worked separately and independently, by simply providing separate filling and emptying pipes. Thus, in say a four compartment vessel (in addition to the ammonia one) charged with lime water, or other alkaline solution. the two first compartments could be conveniently used for absorbing carbonic acid, and the other two for bisulphide of carbon, and other sulphur compounds, by which arrangement the carbonic acid set could be emptied and refilled independently of the other set, or the whole washer could be employed for abstracting carbonic acid, leaving the sulpho-carbon compounds to be dealt with in a dry-lime purifier, the sulphide of calcium condition of the contents of which would be thus maintained, oxide of iron vessels finally freeing the gas of its sulphuretted hydrogen.

But apart from these special and important adaptabilities of the improved washer, the advantage of such a vessel in a gas works hardly requires enumeration. It is for instance the simplest, cheapest, and most effectual means of depriving gas of the vapors of tar, the dregs of which cling to it so pertinaciously, and which is so objectionable in scrubbers and purifiers, that even if otherwise useless it would for that purpose alone be a requisite.

The utility, however, of a really effective washer is by no means restricted to the foregoing applications. Even where scrubbers are in use a washer is a valuable adjunct. A very effective system of purification, where there are say two scrubbers in action, is to employ ammoniacal liquor in the first, and diluted liquor or clean water in the second one, the latter when replaced being used for charging the washer, the order of the operations being first the washer, and then the scrubbers as above indicated. By this system the whole of the ammonia and from 30 to 50 per cent. of the carbonic acid and sulphur can be eliminated in a very facile and inexpensive way. the resulting solution being easily converted into the valuable marketable product, sulphate of ammonia, or disposed of at a





high price to manufacturing chemists to be used for that purpose.

In works having no scrubber or scrubbers, the improved washer may be advantageously used exclusively instead. It is, while equally effective, much cheaper than a scrubber, requires no shafting, belting, pinions, or other moving gear of any kind, and practically may be said to be indestructible, which certainly cannot be said of the best class of scrubbers with their multifarious appliances so apt to get out of order.

In conclusion, the patentee would add that before venturing to bring the improved washer under the public notice of the gas world. he has taken the precaution of practically testing its efficiency, having had one at each of the two stations of the company with which he is at present connected, in operation for some months, with the most satisfactory results.

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 250.

We will now leave the retort-house and turn to the

COAL STORES.

since it is evident that gas coals, more than any others, should, if possible, be stored under cover: not only do they deteriorate from 10 to 15% if exposed to the weather, but the use of wet coal tends to cause the formation of very troublesome impurities in the gas, among others of bisulphide of carbon and of carbonic acid; the presence of moisture in the coal is very objectionable in still another respect since it increases the consumption of fuel.

The coal stores are located at but a very short distance from the retort-house and are parallel to it; they do not require to be very expensive structures and consequently are usually constructed of wood. It is always well to have a very liberal coal supply at hand and it is generally customary to provide a storage capacity for at least three months' supply at the rate of the average winter consumption, in order to be prepared for such emergencies as the interruption of navigation by severe frost or by the great "strikes" which are liable to occur at almost any time. In our case, therefore, two coal stores will be provided, affording us a storage capacity for 4000 tons of coal; they will be 105 feet in length and 60 feet in width, thus storing the coal to a depth of about 15 feet. In several of the more recent and large works both in this country and in Great Britain, great care was devoted to this part of the plant and particularly at the new works at Beekton near London and at Pittsburgh, Pa., these arrangements are said to be very perfect both as regards convenience and economy in handling the coal.

SPONTANEOUS COMBUSTION OF COAL.

Gas coals, like all bituminous coals, are very liable to undergo spontaneous combustion especially when moisture is present. This is partially guarded against by storing them under cover. In most bituminous coals, however, and particularly in our West Virginia and Cape Breton coals, the percentage of sulphur in the form of iron pyrites is so great as to necessitate a further precaution; when, therefore, the coal heaps have attained a certain temperature, they are removed and turned over and this free exposure to dry air usually has the effect of cooling them. A year or two ago, Col. James H. Armington of the Brooklyn Gas Works, made a series of experiments in the direction of determining this temperature, resulting in the indication that the coal is safe until 200° F. is reached. At these works an excellent system of watching the coal heaps has for some time been in use: a number of gas pipes with perforations every few inches, are placed in the heaps some 10 or 15 feet apart; their temperature is daily taken and recorded and any serious rise in temperature is thus immediately observed and localized.

THE EXHAUSTER.

While discussing the hydraulic main, we had occasion to speak of the pressure under which the retorts would have to be worked under the circumstances which there exist; we noted its highly injurious consequences and pointed out the desirability of removing this pressure. It was there stated to be the sum of the pressures due to the hydraulic seal and of the gas in the mains and apparatus; we observed the difficulty of doing away with the former; the only course which would now appear to be open, is to remove the latter element as thoroughly as may be. This usually amounts to several inches of water being the back pressure due to the holders, purifiers, and other apparatus, and the resistance which the gas experiences in its flow through the mains. This is accomplished by inserting at some convenient point in the system of mains what is known as an exhauster, which removes the gas from the hydraulic main as rapidly as it enters it, and which counteracts the back pressure referred to above. Its use invariably brings with it large reductions in the deposit of carbon and better yields, both as regards quantity and quality of the gas. Experiments made several years ago, by Mr. J. A. Sabbaton, indicated a difference of nine percent. in the yield of gas in favor of the exhauster, and the experience of Mr. Cockcroft of Littleborough, England, shows this to be 10 per cent. The great value of the exhauster is, therefore, fully recognized in all works of any magnitude; it is evident, however, that at some point its first cost and the maintenance of its repairs, must exceed the advantages secured by its use. It is difficult to state precisely where this limit is; it has been claimed, however, that all works carbonizing over 1000 tons of coal per annum, can use an exhauster with advantage.

The first exhauster was used by Grafton, whose name has already been associated with the first clay retorts, and was simply a reversed wet gas meter; but it never came into general use, being soon superceded by exhauster pumps. It was found very difficult, however, on account of their reciprocating action, to obtain a steady and uniform flow of gas, and instead of maintaining a vacuum in the hydraulic main, both it and the pressure varied continually. This led to the construction of rotary exhausters, which are now in almost universal use in this country, though not so generally in Europe. Although they may be made to give entire satisfaction, yet all rotary exhausters are open to the objection that they require to be run by power. This was usually supplied by a steam engine, and was the main cause of their limited range of application; recently,, however, the substitution of gas for steam engines has made some progress, particularly abroad, where the Otto and Langen engine is said to give good results; the Haugon engine has for some time been in use at the Boston Gas Works.

This was a most important step, more so even than the introduction of the steam jet exhauster; these are based on somewhat the same principle as the injector; that of Korting is the most recent, and promises to yield good results.

In our case it would be immaterial whether a rotary or a steam jet exhauster be used; if the former class were preferred, the choice would lie mainly between the Mackenzie and the Root's' exhauster; the Jones' was one of the first English exhausters introduced into this country, and is still in use in the Manhattan and, no doubt, in many of our older gas works. The Mackenzie was the first American exhauster; until quite recently it was in almost universel use, and is consequently too well known to require any special comment here. Within the last few years the Roots' exhauster has made some progress, being in use at the new works at St. Louis, Cincinnati and Pittsburgh; we are already acquainted with its principles through the Roots' blower, from which it differs but slightly in its details of construction, and it presents the appearance of a well-designed and well-built machine.

Aside from the fact that the first cost and the running expense of the exhauster are very considerable, it would, if used alone, be open to this very serious objection: its liability to overdo its work by disturbing the hydraulic seal, and thus drawing in atmospheric air, not only through the retorts that are "off", but also through those at work. This, for numerous reasons, is highly objectionable: not only does it give rise to the formation of a very explosive mixture, but it reduces largely the illuminating power of the gas, it is said, to the extent of 50% for every 6% of air, and the presence of nitrogen in the gas can almost invariably be traced back to this same source. Now, the gas is produced very irregularly in the retort-house, and consequently the work which the exhauster must perform varies continually. It is evident, therefore, that it must be regulated by some form of automatic governor; the ordinary steam engine governor, if made sufficiently sensitive, might be capable of performing this duty. It is customary, however, to control the action of the exhauster engine by means of the

GAS GOVERNOR,

the small gas holder of which is subject to all the fluctuations of the gas in the mains; it can be counterbalanced with great nicety to any desired pressure, and it controls the engine by means of a lever attached to it and to the throttle valve.

A further precaution in this connection should be observed by the use of the

COMPENSATOR

which is a very simple and effective device. Like the governor it consists of a very small holder, counterbalanced to any desired pressure, and actuated by a small stream of gas, while a chamber located beneath the holder is connected with both the inlet and the outlet of the exhauster by means of pipes five or six inches in diameter. This chamber contains a valve whose stem is attached to the holder. It, then, the exhauster works too rapidly, the equilibrium between the weight of the holder and the pressure of the gas upon it is disturbed, the holder sinks, opens the valve in the chamber, and thus compels some of the gas to pass the exhauster once more.

BYE-PASS.

The mains and valves belonging to the exhauster should be so arranged, that when absolutely necessary the exhauster may be thrown out and the gas "bye-passed," as it is technically called; it is sometimes made self-acting so that in case of accident to the exhauster and no attendant present, the gas shall find an outlet. The exhauster very rarely requires to be thrown out, and then usually for a short time only as, for instance, for removing any hardened tar which clogged it. To provide against the more serious matter of an accident to the exhauster, necessitating lengthy repairs, it is well to have it in duplicate; in the case of a new gas works, this extra expense would evidently be considered justifiable only very rarely. It is customary, on the other hand, to provide duplicate engines and boilers, since these are more liable to permanent derangement than the exhauster itself.

POWER REQUIRED FOR EXHAUSTER.

In order to determine the amount of work which will be performed by the exhauster, and, consequently, the power which it will be necessary to furnish, two data must be given: in the first place the weight of the gas which it is proposed to pass and, secondly, the maximum pressure under which it is intended to work the exhauster. The determination of this maximum pressure in the case of a projected works can evidently only be a matter of approximation. It is made up of the pressure due to the holders, machinery and apparatus and the resistance to the flow of the gas in the mains; the difficulty obviously lies in the latter elements, since by reason of the many bends, connections and valves in this system of mains no figure can be given for it with any degree of precision. It also depends to a great extent upon the way in which the works are managed, since, in the course of time and unless special care is taken the mains are largely reduced in diameter by depo,

* A Graduating Thesis at the Stevens Institute of Technology.

sits of tar, naphthaline and the like, thereby increasing the resistance, while an additional increase in pressure may be traced back to the machinery and apparatus. Its real value, therefore, is correctly obtained only after the works were in practical operation for some time; in any case like ours a liberal allowance must consequently be made.

We will assume, therefore, that the maximum pressure to be overcome by the exhauster shall never exceed 12″ of water corresponding to a pressure of .43 lbs. per square inch (1″ water = .036 lbs.).

We must, in the first place, proceed to determine the height of the column of gas which would exert this pressure, and in order to do this the density of the gas must be known. We evidently cannot use the ordinary figure .450.500, which is the specific gravity of the gas as it leaves the works ready for distribution; at this stage in the process, that is, immediately after having left the hydraulic main, it contains a very large percentage of impurities, both mechanical and chemical, which largely increase the density of the gas.

Singularly enough no definite data in this direction seem to exist, but the density evidently cannot be very much less than that of air; we shall consequently assume it at .970, neglecting any corrections for temperature and pressure. Now, the weight of one cubic inch of air is .00004655 lbs. and, therefore, that of one cubic inch of our gas is .00004190 lbs. The pressure, then, which the exhauster will have to overcome is that exerted by a column of the gas $\frac{.43}{.0000419} =$ 1026.2 inches or 85.5 feet in height. The maximum capacity of the works will be 500,000 cubic feet per diem and the exhauster will therefore pass about 350 feet per minute weighing 25.427 lbs. When, therefore, the exhauster passes 350 cubic feet against a resistance of .43 lbs. per square inch, it is doing the work to the extent of 25.427 × 85.5 foot-pounds per minute or $\frac{2174}{33000}$ H. P. The efficiency of the exhauster under the most favorable circumstances may be assumed at 50 per cent, and consequently the power required would be $\frac{2174}{33{,}000 \times .50}$ or a trifle more than $\frac{1}{3}$ H. P., theoretically; in practice, however, it is customary to use an engine of from 4 to 6 H. P.

The exhauster is generally selected of such dimensions that it will pass the required amount of gas with a very low velocity, and similarly the exhauster engine has a very low speed of piston. In this way and by the aid of the several accessories of the exhauster, there will be no difficulty in obtaining a uniform and steady flow of gas. At the same time the wear and tear of the machinery is largely reduced.

This will conclude our remarks upon the exhauster for the present, for we shall have occasion to revert to it in the course of this paper.

COMPOSITION OF THE CRUDE GAS.

Before proceeding any further it might be well to examine into the chemical composition of the crude gas at this stage in the process, viz.: immediately after having passed the exhauster. A lengthy discussion, however, would hardly come within the province of this paper, and the following brief summary of the most important constituents of the crude gas will be quite sufficient for our purposes. They are most conveniently classed under four heads, as follows:

First. The real illuminating elements: heavy carburetted hydrogen, benzole, naphthaline, and similar heavy hydrocarbons.

Second. Diluents of a combustible character: mainly marsh-gas, hydrogen, and carbonic oxide; it is evidently very fortunate that such elements exist in the gas, since they serve the purpose of diluting the gases of the first class which are so rich in carbon that, when burnt alone, it would be very difficult to secure their thorough combustion.

Third. Diluents of a non-combustible character, among others carbonic acid and nitrogen, whose presence, even in small quantities, is highly injurious, and

Fourth. Impurities like sulphurous acid, sulphuretted hydrogen, the cyanides and all ammoniacal compounds.

The crude gas also carries with it a considerable quantity of heavy hydrocarbons, which are condensable at even ordinary temperatures and pressures, and which are known under the name of coal tar. It is self-evident that these must be thoroughly removed, and we will now devote our attention to the processes by means of which this is accomplished; these constitute the second great subdivision of our subject, technically called

CONDENSATION.

This process, strictly speaking, comes into play almost as soon as the gas leaves the retorts, since this is deprived of a large percentage of its grosser impurities by the cooling action of the hydraulic main and the mains leading from it to the exhauster. The process is completed in what are termed "condensers." The first of these was the

ATMOSPHERIC OR AIR CONDENSER,

which, for a long time, was in universal use. In one of its numerous forms it consists of an extensive system of large pipes running to and fro, horizontally or nearly so, through the walls of one of the buildings. This is a very common arrangement and one which was adopted in the case of the new works at Beckton, England. In another form a series of pipes is vertically placed upon a large rectangular box, the tops of the pipes being connected by means of U pieces in such a manner that the gas passes alternately up and down the pipes. This form of condenser is still in use at the Fourteenth street station of the Manhattan Gas Works.

In the atmospheric condenser, the gas being cooled simply by the action of the air, the condensation was necessarily imperfectly done in warm and overdone in cold weather, and consequently it is but rarely used in our climate. It may, however, be rendered somewhat more efficient in manner by painting it a white color, since this absorbs heat to a less degree than any other.

In many instances the condenser consists of a series of pipes laid underground, and to a depth of from four to six feet; in this manner the temperature of the condenser is constant or, at all events, very nearly so throughout the several seasons, and it becomes, indeed, quite an efficient piece of apparatus.

[To be continued.]

The Cost of Light.—A number of experiments have been made lately in London to test the comparative cost of illumination with the various materials used for that purpose. Below is the result, the first column containing a description of the materials tested; the second, the price of the material in London, reckoning 24 cents to the shilling; the third column shows the duration of the light furnished for one cent the light being reduced to equal one sperm candle. With the exception of the last named material, common gas, the prices do not vary sufficiently from those which prevail here to effect the value of the comparison. London gas is reputedly of inferior illuminating power, so that the economy of its use can scarcely be so much greater than ours as its cheapness would seem to indicate.

		h.	m.
Standard sperm candles, per lb...	$0.48	1	7
Best wax candle, per lb.....	.48	1	6
Sperm oil in moderator, per gal...	2.28	1	12
Belmont sperm candle; per lb.....	.30	1	27
Stella, or Burmese wax, per lb....	.30	1	37
Petroleum candle, per lb.....	.36	2	15
Composite candle, No. 1. per lb...	.22	2	5
" " No. 3, " ...	.16	2	45
Common dip candles, per lb.....	.12	2	52
Almond oil, in moderator, per gal.	2.22	3	..
Colza, per gal.....	1.20	4	37
Paraffin oil, in lamp, per gal.....	.72	9	35
Common gas, per 1000 ft.....	.90	26	...

The price of gas being about three times as great in most American cities as in London, no such marked advantage as appears in the table can accrue from its use on the score of cost. Still, it must rank among the most economical of artifical illuminations—at least three or four times as economical as common candles for a given amount of light.—*Coal Trade Journal.*

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.

The St. John and Rockwell Scrubber.

Mr. Editor: Some time has elapsed since the scrubber of the St. John & Rockwell Company has had a statement furnished in its behalf, and I would esteem it as a great favor to have a place in your columns for the publication of some facts for the gas manufacturers to peruse.

As usual, many theories have been propounded which have evoked learned discussion on the apparatus employed by the gas manufacturers of all countries, and particularly in Great Baitain, but without any satisfactory conclusions being attained; and it is possible the theories here advanced may be thrown into the limbo of rejected scientific speculations—nevertheless I shall do my best, without fear of ridicule, to lay it before the public, especially as some of the theories that may be discarded have been presented by those who possess a higher reputation for scientific research than I can lay claim to.

It is now about four years since the scrubber of the St. John & Rockwell Company was first brought into notice. Its principles and workings were fully set forth in the columns of your Journal; and, after much labor and argument, one was constructed at the works of the Harlem Gas Light Company, at Harlem, New York. Like all other new devices or machines, it was not quite complete; but, in a very short space of time, the adjustments were all placed, and the scrubbers set to work on December 31, 1873, and has never been idle during the meantime, always performing its work in the most satisfactory manner. This would seem to corroborate the theories advanced and argue well for its success, also to rebut the many theories and prophecies that it would be but a very short time before it would become choked or closed with tar, etc. Such, however, has not been the case. At the time when this scrubber was first presented to gas manufacturers there were many theories and arguments advanced against it. One, in particular, was that the gas was not properly condensed. How could it be possible with such a small scrubber. *Humbug! Fraud! Can't be so!* Why we cannot always cool our gas so that it is fit to enter the purifiers, and we have six to eight hundred feet of vertical pipes, with a spray of water in each, besides large cylinders, with intermediate layers of coke, breeze, etc., for the gas to pass through, with water also spraying upon it; and yet, sometimes, we fail to condense or cool the gas.

In reply to this—will refer to the one at the Harlem Gas Works. That the gas, after passing through it, has a cooling influence upon the hand; also, that it will not soil white fabrics when allowed to escape upon them through a three-eighth of an inch pipe at the outlet of the scrubber. Again—quantity and quality.

It was, and is now claimed, that this scrubber is the most complete and effectual in its action of any yet constructed. The reports of Dr. Chandler and Prof. Wurtz, upon examinations made at the Harlem Gas-Works, as well as the books of the Harlem Gas-Light Company, prove that there is more than 10,000 cubic feet of gas from 17 to 19 candle power in a ton of ordinary caking coal. When this was made known some doubted, but this has been exceded during the meantime. In fact it is accomplished daily. It has been published that not less than 11,000 cubic feet of gas from 17 to 19 candle power made from such coal as Murphy Run, Penn, Westmoreland and Waverly, without any enriching material is guaranteed by the use of the scrubber of the St. John & Rockwell Company. Here is an important point. If the percentage of cannel coal can be saved to gas companies, it amounts to a very large sum; for instance, in places where the illuminating power of the gas has to be of a standard of 16 candle power, cannel coal is gen

erally employed; and as the price of this coal is nearly twice that of caking coals, it can be readily shown (so that those who run may read) on a consumption of 80,000 tons of coal, and using 20 per cent. of cannel, making 16,000 tons. This would cost about $5 more per ton than the ordinary caking coals, and, at the same time the quantity and quality of the coke is not increased or improved—making $80,000 in one year. I have named the above figure merely to explain some very large companies using much more. In some seasons of the year the percentage of cannel is less, say, 10 per cent. in summer months, but it would be safe to name 15 per cent. as a fair average for the year. This would still be the large amount of 12,000 tons, at the increased price of $5, making $60,000 as a saving. The theories that were advanced at the time this scrubber was first presented have been retained by others.

I was pleased to read, in your issue of Nov. 16th, 1876, that Mr. William Farmer, an engineer of ability, who quotes largely from Bowditch, in support of the same principles set forth. In speaking of naphthaline, etc., he says: "To get over this difficulty we must adopt an apparatus that will keep and utilize all of the hot tar that we do get, and not let it cool immediately and escape to the tar well." I also notice the weakness exhibited in the working of the zig-zag scrubber, as his (Mr. Farmer's) explanations recommend "that from this apparatus the gas should next pass on to the ordinary multitubular condenser, to be reduced to the proper temperature before it enters the water scrubber," making quite an extensive sequence of apparatus, as well as expensive, to construct, in the first instance. This zig-zag scrubber, no doubt performs its part, in connection with the multitubular condensers and washers, and it would be remarkable if it did not.

In my reply to Mr. Smedberg, in your issue of April 2d, 1875, this same inactivity, or weakness, was dwelt upon relative to the working of the Pelouze and Audouin condenser, which involved about the same amount of apparatus, including the reversed flow and differential action of an immense volume of water, imperfectly arresting the tar, etc. I will again repeat what I then said—that all of the above principles have been in constant operation without involving the necessity of any subsequent condenser ever since the scrubber of the St. John & Rockwell Company has been working, which is nearly five years. We have long been convinced that the liquids set free in the distillation of the coals were of great value in treating the vapor successfully, and it is upon this that our patents have been secured. We bring forward to the scrubber all of the liquid products from the hydraulic main, passing them through a series of boxes, utilizing them until all traces of tar, etc., are absolutely removed; at the same time the gas is cooled also enriched by the absorption of the benzole and coal tar naphthas which are ever present.

Much has been written and expressed relative to condensation, also of the quantity and quality of the gas made from bituminous coals, but the sulphur question has been more or less overlooked. It was sulphur that Prof. Silliman termed the "black beast," and was dreaded by gas manufacturers. I believe all are a unit upon this question. It is by analysis that the quantity of sulphur in purified gas is determined. This subject has been discussed for a long time in Europe, and, in 1860, the Metropolis gas act, in London, was passed, which required purified gas not to contain more than 20 grains to the 100 cubic feet. This seemed to baffle the art and skill of Great Britain to comply with this statute, and, in almost every instance, failed.

I quote the report of the lamented Dr. Letheby, (from volume xxi, 1872, of the London *Journal of Gas-Lighting*) who was the chief gas examiner appointed by the Board of Trade. In his quarterly report to the corporation of London, and the Metropolitan Board of Trade (*being 12 years subsequent to the passage of the act*) it appears that the following are the maximum, minimum, and average amounts of grains of sulphur, per 100 cubic feet of gas, in the different companies:

Chartered Company.

	Maximum.	Minimum.	Average
Common gas, Cannon street...	46·5	26·7	36.90
" " Gray's Inn road.	52·8	21·5	40·30
" " Friendly Place..	57·0	10·5	21·03
" " Arundel street..	37·4	31·2	35·90
Cannel gas.....	32·8	24·4	28·54

Imperial Company.

	Maximum.	Minimum.	Average
Common gas, Oakley square..	38·0	28·7	34·05
" " Camden street..	33·1	19·1	27·00
" " Graham street..	31·3	21·5	27·26
South Metropolitan.....	39·4	29 6	35·23

Dr. Whitmore's report on the quality of the gas supplied in St. Marylebone, January, 1872.

Imperial Company's Gas— Mean quantity of sulphur per 100 c. f.	33·12
Chartered Company's common gas.....	32·13
" " cannel gas.....	26·76

I might quote about the same results throughout the whole year, but this will do for the present. It is true that in some extreme cases, where the greatest care was exercised, the above quantities have been reduced by some companies, but the fluctuations show that it was not altogether reliable. I have selected the above companies, not from any choice of my own, but that they were selected by others, and only done in this case to prove how hard it has been for the respective companies to comply with the requirements of the statute. It must be understood that I firmly believe they were doing all that could possibly be done with the apparatus employed.

I do not propose to know how well gas companies are doing in this country, relative to the amount of sulphur left in the purified gas, but am of the opinion that the same difficulty is present here as well as in Europe. That it can be improved there is not the shadow of a doubt. Certainly no change of purifiers or material is employed. Some may doubt that sulphur can exist in purified gas without being detected by the ordinary lead paper, such as is generally employed; but, nevertheless, it is true, and can exist to an alarming extent, as high as 40 to 50 grains, or more, in 100 cubic feet. If this is so objectionable, and can be removed so easily, at the same time reducing the expense of purification, as well as not to impair the illuminating power of the gas, also not reducing its quantity, then it would seem reasonable to conclude that a method whereby all of this could be accomplished with so much economy and advantage would be acceptable.

I now present Dr. Chandler's report and examinations recently made at the Harlem Gas Works, upon the method and principles embraced by the scrubber of the St. John & Rockwell Company—

SCHOOL OF MINES COLUMBIA COLLEGE,
COR. 49TH ST. & 4TH AVENUE,
NEW YORK, Oct. 12, 1876.

Burr Wakeman, Esq., President St. John & Rockwell Scrubber Company, 61 Liberty st., N. Y.

My Dear Sir: In the tests made upon the gas at the Harlem Gas works, with reference to its purification by the passage of the gas through a scrubber constructed upon the principles of your apparatus, *i. e.*, washing the gas with the products from the hydraulic main, but consisting of six boxes instead of four or two, the following results were obtained:

The raw gas found to contain 54·77 grains of sulphur per 100 cubic feet; test made Sept. 22d, 1876. The gas, after passing through the six boxes, and before passing the purifiers, contained 16·26 grains of sulphur; test made Sept. 23, 1876. After passing the six boxes, and the purifiers also, the finished gas contained 5·31 grains of sulphur; test made Sept. 25th, 1876.

That this result is not exceptional, when both tar and ammoniacal liquor were passed into the apparatus to effect the purification of the gas, is shown by other tests made at another time upon gas purified in that manner. The results were as follows:

August 14th, 1876, the finished gas contained, in 100 cubic feet, 5·45 grains of sulphur; August 17th, 1876, the finished gas contained, in 100 cubic feet, 5·50 grains of sulphur.

It appears, therefore, that by the use of an apparatus constructed on this principle, with six boxes, illuminating gas can be purified so as to contain between five and five and a-half grains to the hundred cubic feet. I am informed that the coal used at the works while these experiments were in progress, was Murphy Run.

Very truly, yours,
C. F. CHANDLER.

Here the remarkable action of this scrubber is clearly shown. It may be explained that the crude gas analyzed had passed the six boxes without any of the liquids being present as a matter of convenience. There may have been more sulphur combined with the crude gas than 54·77 grains, as the gas passing through the perforations would possibly leave a portion of it; as it is there was over 36 grains per 100 cubic feet removed, which is conclusive of the wonderful power of this scrubber. Less sulphur is found in combination, after passing the boxes, than is found in a majority of cases in purified gas. I will state further, in explanation, that the seal employed in each box was one inch, so that the question of back pressure may not be seriously made. It may not be generally known that we have constructed one of our scrubbers at Quebec, in February last, which has four boxes. The results there corroborate the theories advanced relative to the purity of the gas on leaving the scrubber. It may well challenge a parallel. I was there on the 5th of August, 1876, and found it working very well indeed—they were making about 45,000 cubic feet of gas per day, and the purifiers were not changed in 31 days, making 1,395,000 cubic feet of gas purified by 130 bushels of lime—over 10,000 cubic feet purified per bushel of lime. In the report of Dr. Chandler, published in the GAS-LIGHT JOURNAL of January 16, 1875, it was found that there were 23·586 grains of sulphur per 100 cubic feet of gas, and 2·65 grains of ammonia in the same quantity. The ammonia was very satisfactory; but the sulphur was not low enough to satisfy me that the scrubber was working to its full capacity. Again, the analysis was made from the working of two boxes, hence the introduction of four at Quebec, and six with this last examination of Dr. Chandler.

This is the point upon which all hangs—the boxes will be increased until the last vestige of sulphur is extracted. The bugbear of bisulphide of carbon not being known in this country, as expressed by Mr. Cathels, of Montreal, in your issue of Nov. 3d, 1876, will then quietly vacate the premises so long occupied, and make room for a purer, more healthy, and better quality of gas. If all this is accomplished before its presence has been detected so much the better for all concerned. I will say (what every one knows) that sulphur in combination with gas after being made is still sulphur at the point of combustion, and must form sulphurous acid, which is subsequently converted into sulphuric acid—and here is the great objection. It is this that is destructive to furniture, fabrics, etc. It is the removal of bisulphide of carbon I am at work at, and do not propose to stop until it is accomplished, particularly when it can be done without any detrimental effect upon the quality and quantity of the gas; and, certainly, without any extra expense (for the scrubber is automatic), also, it being the spirit of the age in which we live, to excel if we can, without tresspassing upon the rights of others, and this shall be my guide.

In conclusion, Mr. Editor, I will say in behalf of the St. John & Rockwell Company, of New York, that they are ready to negotiate for the construction of their scrubbers in any part of the United States, at reasonable rates, and warrant the published results and statements:

1st. The absolute disposition of all the tar, etc.

2d. Not less than 11,000 cubic feet of gas, of 17 to

19 candle power per ton of 2240 lbs. of such coal as Murphy Run, etc., without any enriching material, cannel coal or otherwise.

3d. That there shall not exceed 5·50 grains of sulphur in 100 cubic feet of gas, made upon any scale from 5,000 to 10,000,000 cubic feet per diem.

4th. That the present expense of the purifying department shall be reduced 30 to 50 per cent.

Yours, very truly,

W. H. St. John,

59 & 61 Liberty Street, New York city, December 14, 1876.

Illuminating Power of Coal Gas.

[From the London Journal of Grs Lighting, Nov. 14.]

In the London Journal of the 22nd of February last (vol. 27, page 282) was published an able *resume* of a paper read before the Institution of Civil Engineers, by Mr. William Sugg, "On Estimating the Illuminating Power of Coal Gas." We give below the discussion upon it.

Mr. Sugg said since the paper was written, he had combined the whole of its recommendations in an instrument, in which the dial was divided off so as to show the quantity of gas required to give a light equal to any number of sperm candles up to 16. A burner was fixed to it which, when the flame was exactly at the height of three inches, gave always a light equal to 16 sperm candles. The quantity of gas required to produce light of that intensity would vary according to the quality of the gas, and was shown in the tables.

Dr. Letheby remarked, through the secretary, that Mr. Sugg had done good service by bringing this important subject before the Institution, with a view to discussion; for it must be admitted that the present means and parliamentary provisions, for estimating the illuminating power of coal gas were, as Mr. Sugg said, in an unsatisfactory condition. He might add, indeed, that this was not only the experience of practical men like Mr. Sugg, and the gas testers appointed under various Acts of Parliament, but it was also seen in the difficulties and disputes which were constantly arising whenever gas companies and local authorities were in conflict, as was too often the case, on the question of the illuminating power of the gas supplied to the public. These difficulties began about the year 1848 or 1849, when, at the instance of three distinguished chemists, who had passed away—namely, Prof. Graham, Dr. Lesson, and Mr. Cooper—the Great Central Gas Consumers Company adopted, under severe obligations, a parliamentary standard of illuminating power, and a prescribed method of determining it, the standard being an illuminating power of 12 wax candles of six to the pound, each consuming 120 grains of wax per hour; and the gas was to be burnt at the rate of five cubic feet an hour from an Argand burner of 15 holes and a 7-inch chimney. It happened that he was the officer appointed by the Corporation of London in 1850, under the provisions of the Great Central Company's Act, which had then just become law, to test the quality of the gas supplied to the city, and to see that the obligations of the company were duly fulfilled. This was the first appointment of the kind that was ever made; and he soon found that all the provisions of the Act for estimating the illuminating power of the gas were radically unsound and unreliable; in fact, the whole subject of gas photometry was in a crude and imperfect condition, and he felt that it must be reformed from end to end. The wax candles, for example, prescribed by the Act, were among the worst sort of candles that could be used for photometrical purposes; and the reason was obvious, for as a wax candle, like a common tallow candle, required snuffing, and grew dimmer and dimmer as the head of carbon accumulated upon the wick, it was a difficult question to decide when that delicate operation of snuffing should be performed. One of the first things, therefore, which he did was to rectify the standard candle; and after about one thousand experiments for the purpose of determining the relative illuminating power of wax and sperm, he adopted the latter, using a plaited wick which snuffed itself. This had been the standard candle from that time to the present, for it was adopted by Parliament in 1852. He moreover used two candles instead of one, in order that the light might be intensified, and the rate of combustion equalized. This, also. had become the practice in photometry. After a time, however, the sperm candle became a subject of perplexity, from the circumstance that during the American war, when long-fibre cotton was difficult to obtain, a short-fibre cotton was used in the construction of the wick, and thus the combustion of the candle became irregular. More recently, in consequence of the increasing value of spermacetti, the candle was frequently adulterated with paraffin and stearic acid, so as to be untrustworthy as a photometrical standard. There was a want, therefore, of a radical improvement in this particular. In the next place, the photometer was a very imperfect instrument, with reflecting surfaces, and with the Bunsen disc exposed on both sides to extraneous light. This he remedied by the use of screens; and by enclosing the disc in a chamber, or camera, which only permitted the access of the direct light from the gas and the candles, as was seen in the photometer which bore his name. The burner also, which was described in the Great Central Company's Act as an Argand of 15 holes with a 7 inch chimney, was so constructed by different makers as to give, with the same gas, when burning at the same rate, an illuminating power that ranged from about 10 to 15 candles. This was caused by the want of uniformity in the size of the apertures through which the air passed to the interior of the flame. There was not, in fact, at that time, the slightest provision for the proper adjustment of air to gas; and therefore, with different burners of Act of Parliament quality, the photometrical results were most discordant. Very little experimental inquiry showed that the smaller the apertures, and the higher the pressure at which the gas issued from the burners, the lower was the illuminating power; and, on the other hand, the larger the hole which gave access of air to the interior of the flame, the lower also was the illuminating power. A careful examination of these facts by Mr. Sugg and himself led to the construction of the burner which bore their names, and which, until recently, had been the standard burner for photometrical purposes—the size of the internal hole being graduated according to the quality of the gas; and thus, with the assistance of perforated discs upon the gallery of the burner, the proper adjustment of air, and thereby the proper combustion of gas of different qualities, had been approximately secured. More recently, however, the improvements of Mr. Sugg in the same direction had produced a still better burner, which was rightly proposed as the standard burner for general use. These improvements consisted—first, in the reduction of the pressure of the gas to a minimum at the point of combustion; secondly, in a well regulated supply of air to the interior and exterior of the conical flame; and thirdly, in the adoption of means for keeping down the temperature of the burner, in order that issuing gas might not be expanded by the heat of the burner. Possibly further improvements might yet be made in the construction of test-burners; but sufficient progress had already been made to justify the proposition of Mr. Sugg, that his burner should be accepted as a standard instrument, so that litigation and trouble on this head might be in future prevented. And now came the important question—how was the burner to be used? Should it be after the old parliamentary fashion, of forcing five cubic feet of gas through it per hour, whether the burner consumed it properly or not, or should the quantity of gas necessary to produce a flame of given intensity or of given measurement be determined? It was, he thought, abundantly evident that the present practice in this country, of forcing five cubic feet of gas per hour through a burner, whether it would effectively carry this quantity or not, was radically wrong; for with any given burner and chimney suited for the proper combination and full development of the illuminating power of that quantity of gas, it must be that when gas of inferior quality was passed through it at the same rate, the gas would be over-oxidized, and, therefore, made to appear of less illuminating power than it really was. On the other hand, superior gas would be under-oxidized, and would escape as smoke, without developing its full value. This was actually the case with the Birmingham burner referred to, which, at the time of the passing of the Company's Act in 1864, and at the request of the parliamentary committee, he designed, in conjunction with Mr. Bowditch, as the standard burner for 14-candle gas. They were compelled to use a metal top, in accordance with the instructions of the committee; for the Corporation of Birmingham, who were in opposition to the gas company, would not have a burner with a steatite top, and this they would now regret, having lately purchased the works of the company. This burner was exactly suited for 14-candle gas, but if the gas got better or worse than this, the burner would do it injustice. The same was the case with other standard Argand burners, as the Dublin, Leamington, etc., which had been constructed on their principles; and, therefore, if Parliament insisted on the passing of five cubic feet per hour through a test-burner, the gas companies should be permitted to select that burner which, while fulfilling the conditions of the Act of Parliament, developed the illuminating power of the gas to the fullest extent. It was far better, however, that the second alternative should be resorted to—namely, the use of the standard burner, like a standard measure, as Mr. Sugg proposed, and the determination of the quantity of gas to be passed through it so as to develop a flame of standard intensity or standard height. The intensity of the flame might be measured, as was the practice in France, under the advice of Dumas and Regnault, by keeping it exactly equal in illuminating power to that of an Argand burner, of prescribed conditions, consuming a given quantity of colza oil. Or it might be measured as he had proposed, by ascertaining its penetrating power in passing through a medium of given opacity—say a piece of dark bottle-glass, cut in wedge shape. But if the height of the flame were the test, nothing was easier than to fix on such a height as would be best suited for the maximum development of light, and then to determine the quantity of gas per hour necessary to produce such a flame. Long ago the late Dr. Fyfe showed that the quality of the gas, as regarded illuminating power, might be determined by burning the gas from a jet of given dimensions, and observing the rate of combustion necessary to produce a flame of given height, or by observing the height of the flame when the gas was burnt at a given rate. Under the name of Lowe's jet photometer, the last method was practically in use at gas works for the purpose of ascertaining the quality of the gas; and there was no reason why the other plan might not be pursued, for the principle was manifestly correct. The illuminating power of gas was dependent on the proportions of the rich and heavy hydrocarbons which the gas contained; and as these were of much higher specific gravity than the hydrogen and marsh gas, which were the chief constituents of coal gas, it was evident that the density or specific gravity of the gas would rise in proportion to the quantity and quality of the hydrocarbons contained in it. Now, the experiments of Dr. Fyfe, as well as the more recent investigations of Prof. Graham, had shown that the flow of gas through a small orifice was inversely proportional to the gravity of the gas. A light gas, for example, would pass much more freely and easily through such an orifice than a heavy gas. The law, indeed, as expressed by Prof. Graham was, that the velocity, or rate of flow, was inversely as the square root of the density. If, therefore, the flame were used as the exponent of density; as it really was in the case of the heavy hydrocarbons, its height under a constant rate of flow would determine the density or quality of the gas: while with a flame of a given height, the rate of flow would be the means of arriving at a like result. This was the principle which the author had in view, and no doubt it was

susceptible of practical application. His experiments, indeed, showed that this was the case, and that the results obtained by it were accurate and trustworthy. The simplicity of the process was, moreover; a great recommendation, as it was capable of being applied under all circumstances, without the complicated machinery at present in use; only a standard burner being required with a handy, portable, and accurate meter, together with a delicate thermometer and a good aneroid barometer.

Mr. Vernen Harcourt remarked that he had an opportunity of seeing the apparatus previously, and therefore could not presume to offer an opinion upon its practical value. One or two points mentioned by the author were of great interest, and one certainly which he had not previously understood, viz,, that flat flames produced by different samples of gas at the same burner did not differ from one another except in size, and that provided the total surface of the flame was the same, whatever the quality of the gas burnt, the amount of light it gave was the same. That was certainly at variance with common observation as to coal gas. Remarks were often heard as to the apparent brilliancy of the light, which were intended to refer to the effect produced by a given area of flame upon the eye; but from what Mr. Sugg said he understood a 3-inch flame, from the same burner, would always give the same amount of light, whatever the quality of the gas. Another question suggested by the paper was as to the reason why the size of the flame should vary, as it was known to vary, other conditions being alike, with the quality of the gas. One reason for this was the decomposition of the heavy hydrocarbons at the high temperature of the flame. It was well known to chemists that at that high temperature these hydrocarbons were resolved into a larger volume of lighter gases. As soon as the gas had passed through the burner, and had been heated, part of it was decomposed, and a larger volume of gas was formed; so that actually with a richer gas, though the quantity passing through the meter was the same, the quantity in the flame was a larger volume, and, therefore, to obtain a flame of given length, it was necessary to burn less gas as measured by the meter. He did not understand why an Argaud burner with a 3 inch flame was used, because, comparing the instrument with the jet photometer, it appeared to have at least two disadvantages. It would seem an easy matter to determine the height of the flame, but actually its top consisted of a number of shifling peaks, and although it was possible to arrive at some rough average, yet its position could not be determined with accuracy. The error so produced appeared to be increased by using so short a flame. With a flame six inches long, a small error as to the position of the top of the flame mattered less than in the adjustment of a 3-inch flame. The uncertainty as to the position of the top of the flame in the latter case was much greater, and the error caused by that uncertainty was greater. He could not understand why, in this instrument, such a flame was adopted, instead of the long flame with a well defined top which was used in the jet photometer.

Mr. Law said that portion of the profession engaged in gas engineering was much indebted to Mr. Sugg for the attention he had given to the subject of the standard gas burner. No doubt the burner he had introduced was that which gave the most uniform results, and without which the present perfection of gas photometry could never have been attained. The most imperfect part of photometrical apparatus was that employed as the standard by which the instrument could be perfectly adjusted. Whatever photometer was used—whether Bunsen's or Wheatstone's, or the wedge—they all depended ultimately upon the estimation of the human eye; and not only did that estimation differ in different individuals, but in the same individual in different states of health or other physical circumstances. He had placed on the table an instrument which he believed would become the standard photometer, because it was entirely independent of the physical conditions of the human eye, and really measured the intensity of the light by the velocity of its revolution. It was a recent discovery of Professor Crookes, and seemed to presage some great discoveries in reference to those extremely attenuated media of which Mr. Grove first showed the correlation, such as light, heat, magnetism, actinism, and electricity. The instrument was actuated by the intensity of the light. The cause of its revolution was not so important to inquire into in reference to this subject, but it was a fact that the velocity would vary according to the intensity of the light. It was most sensitive in its operation; it consisted of arms of aluminium with discs of talc, which were black on one side and polished on the other, and the influence of light upon it produced the revolution; it was in a perfect vacuum. The mode of making use of it would be to let it move at such a low velocity as would enable the revolutions to be counted, and the number of revolutions would determine the intensity of the light. If it was further improved by making one of the arms magnetic, a registering apparatus might be put outside, so that the number of revolutions might actually be recorded. In reference to the proposed mode of estimating the illuminating power of gas, he could speak from experience of the great value of having some simple mode which did not depend upon the estimate of the eye of different persons, such as in the Bunsen photometer; for he knew by experience that fiscal engineers in foreign parts, not accustomed to this kind of observation, would estimate the gas at two or three candles different from the practised gas maker who was used to the instrument.

Mr. Barlow, vice-president, did not think Mr. Crooke's instrument had been presented in a form suitable for measuring light alone, because it was affected not only by light, but by heat. It would require some provision to exclude the action of heat, because the worst gas was that which gave much heat and little light; and the instrument would be caused to revolve by gas of inferior quality almost as much as it would be by gas of high illuminating power. Care would therefore be required to exclude the effect of heat, otherwise bad gas might be registered as good.

Professor Abel observed that Mr Crookes had already given serious attention to that subject, and no doubt would be able so to arrange the apparatus as to shut off the rays of heat, and obtain trustworthy records of the different illuminating powers of the light emitted from different sources. He had sanguine anticipations of the results that Mr. Crookes would obtain in this direction. He had listened with great interest to Mr. Sugg's communication. The only point that occurred to him in reference to it was the one Mr. Harcourt had noticed—viz., the uncertainty of measuring the exact height of so short a flame.

[To be continued.]

Cleansing Old Iron Water Pipes at Elgin.

A short time ago the commissioners of Elgin resolved to cleanse the old iron water pipes, and relay them in those parts of the town where they would be of use. The first portion of the pipes (which had been in the ground for more than twenty years, and were much incrusted) has now been cleansed. The process was gone through at New Elgin, where a rough furnace was erected to meet the object in view. The pipes, two at a time, were laid into the furnace, and subjected to an intense heat for about half an hour. The action of the heat loosened the incrustation of the pipes, and when the pipes were lifted out of the furnace the greater portion of it at once fell off. The most troublesome portion of the work, however, remained to be done. The pipes had to be cleaned with a spring scraper, made to exactly fit the size of the pipe. After undergoing this work, the pipe was allowed to cool till it was in a fit condition to be dipped into a "well" some 12 feet deep, containing Smith's patent solution, where it remained for nearly a minute; after which it was taken out, and presented all the appearance of a new pipe. By the adoption of this process the town will, it is said, be 300*l.* richer than if the old pipes had been sold as mere metal, and new pipes bought to replace them.—*Ironmonger.*

Chemical and Scientific Repertory.

Method of Determining the Hardness and Quality of Steel.—M. A. Chary heats pieces of a given size as high as they will bear without burning, and then bends them by blows of a hammer to and fro until they break. Steel not red-short should stand at least ten such bendings before breaking.—*Ironmonger.*

The Metric System.—At the recent meeting of the American Pharmaceutical Association, a lengthy report was presented urging the advantages of the metric system of weights and measures, which have now become the legalized standards of more than half of the civilized world; and proposing the formation of a permanent committee of three to further the introduction of the system into general use in the country. —*Druggists' Circular.*

The San Francisco Water Works.—Richard Ives, of San Francisco, is at St. Louis, and is negotiating with the Vulcan Iron Works for forty thousand tons of iron plates, to be converted into pipe, for conducting water from the Sierra Nevadas to San Francisco, a distance of one hundred and twenty miles. The contract will amount to about two million dollars. —*Hydraulic Engineer.*

Poisoning by Illuminating Gas.—A servant girl, occupying a small room, so "turned off the gas," on going to bed, as to allow a large volume to escape into her room. In the morning she was found asphyxiated, unconscious and nearly pulseless. Recovery in about four hours took place, under treatment by fresh air and spirits of ammonia, fifteen drops every ten minutes being given at first.—Dr. R. Dexter, in *Journal of Nervous and Mental Diseases.*

Dynamite.—Dynamite is being successfully used in Scotland, in clearing land of trees, stumps and boulders. The boulders are pulverized by merely placing the dynamite on the top of the stone, covering it with wet sand and fired with a fuse in the ordinary way. Trees and stumps are torn up by the roots and split into kindling by placing a small cartridge of the explosive well into the side of the stump a little below the surface.— *Western Manufacturer.*

Smoke Consumer.—Some ingenious Englishman, it seems, has solved the problem of a simple, cheap and effective smoke consumer for steam boilers. This is done by boring just above the fire door of the boiler a couple of circular holes of about two and a half inches diameter, and then insert two pipes, which run at the top of the furnace for about one third or half its distance. A small pipe connected with the boiler drives a jet of steam into each of the pipes, which thus creates two strong draughts of air. This air is rarefied by the steam, and is driven right into the center of flame and smoke from the furnace, thus precipitating the carbon and preventing its escape in those dense clouds which are so offensive in large cities.—*Ibid.*

Steel Belting.—A patent is said to have been applied for for steel belting, for which great superiority is claimed over leather or rubber belting. In the first place it costs a third less than leather; second, it will not stretch or get out of shape; third, it is quickly made and there is an inexhaustible supply of the raw material in the country. It is claimed that the steel can be made and rolled into belting for five cents per pound As it need not be more than one-sixteenth of an inch in thickness for most of the belting, it will weigh but little per foot. A process for slackening and tightening the belts is provided that takes but a few seconds and does not disturb the jointings, which is claimed as another great advantage over the strings and facings of the leather belting. The invention is thought to be an important one, and calculated to be of great service to manufacturers.—*Ibid,*

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TUESDAY, JANUARY 2, 1877.

On the Preservation of Ice at the Bedside.

Mr. Sampson Gamgee, Surgeon to the Queen's Hospital, Birmingham, in a short article (*Lancet*, June 10, 1875) calls attention to this subject. His practice for some years has been to cut a piece of flannel about nine inches square, and secure it by ligature round the mouth of an ordinary tumbler, so as to leave a cup-shaped depression of flannel within the tumbler to about half its depth. In the flannel cup so constructed pieces of ice may be preserved many hours, all the longer if a piece of flannel from four to five inches square be used as a loose cover to the ice cups. Cheap flannel, with comparatively open meshes, is preferable, as the water easily drains through it and the ice is thus kept quite dry. When good flannel with close texture is employed, a small hole must be made in the bottom of the flannel cup, otherwise it holds the water, and facilitates the melting of the ice, which is, nevertheless, preserved much longer than in the naked cup or tumbler. In a room 60° F., Dr. G. made the following experiments with four tumblers, placing in each two ounces of ice broken into pieces of the average size for sucking. In tumbler No. 1 the ice was loose. It had all melted in two hours and fifty-five minutes. In tumbler No. 2 the ice was suspended in the tumbler in a cup made, as above described, of good Welsh flannel. In five hours and a quarter the flannel cup was more than half filled with water, with some pieces of ice floating in it; in another hour and a quarter (six hours and a half from the commencement of the experiment) the flannel cup was nearly filled with water, and no ice remained. In tumbler No. 3 the ice was suspended in a flannel cup made in the same manner and of the same material as in No. 2; but in No. 3 a hole capable of admitting a quill pen had been made in the bottom of the flannel cup, with the effect of protracting the total liquefaction of the two ounces of ice to a period of eight hours and three quarters. In tumbler No. 4 two ounces of ice were placed in a flannel cup made, as above described, of cheap, open flannel (10*d.* per yard), which allowed the water to drain through very readily. Ten hours and ten minutes elapsed before all this ice had melted.

A reserve supply outside the bedroom door can be secured by making a flannel cup, on the plan above described, in a jug, and filling it with little lumps of ice—care being taken that there is space enough below the bag to allow the water to collect and leave the ice dry. This provision will allow ice to be used during the hottest night, without the supply failing, or the patient being disturbed—two very important considerations. The real therapeutic benefit of ice is only produced in some cases by its free use, and its soothing and stilling effect must be aided by the most perfect surrounding quiet.—*Druggists' Circular.*

The Mississippi Jetties.

We learn that for some time past the channel between the jetties, at the mouth of South Pass, is everywhere more than two hundred feet wide for a depth of 20 feet at average flood-tide, and that in the middle of this wide channel the depth is more than 22 feet. This is equal to from 22½ to 23 feet at the highest tide at South Pass, when a range of three feet tide, with a channel depth of 19½ feet, for from 80 to 100 feet in width, is usually reported at Southwest Pass. Therefore, it is seen that the jetties have given, though yet in an incomplete state, a magnificent channel across the South Pass bar to sea, twice as wide and several feet deeper than has ever been obtained across the Southwest Pass bar. If this is considered as any indication of a failure of the jetty system, then we should welcome all such failures; they are what we should pray for earnestly. All through South Pass, from its head to the jettied channel over the bar, as is generally known, the depth exceeds thirty feet for more than two hundred feet in width.

We are informed that the works required to confine the flow of water from the main river, above the common head of the passes, into South Pass, so as to secure a like deep channel entrance to South Pass over the river middle-ground shoal above its head, are being energetically prosecuted, with every prospect of early succes. Already, notwithstanding the low stage of the river, the one-dipper dredge-boat at work there to expediate the cutting out of a deep channel entrance, has succeeded, as we are assured, in obtaining a depth of inlet of from twenty to twenty-two feet across this shoal, which the tidal current suffices to maintain and widen. Soon, we are told, two more powerful dredges will be put to work there, and, with three boats working together, an entrance channel across this hard sand middle-ground shoal, of sufficient width and depth for the largest class of ocean steamers, even at the present low river stage may be expected at an early date. With the river at the height it was three months ago, we would have even now a clear and unobstructed channel of more than 22 feet in depth, from New Orleans to the sea, through South Pass.—*N. O. Picayune*

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,
24 PINE STREET, NEW YORK CITY.
JANUARY 2, 1877.
☞ All communications will receive particular attention

	Capital.	Par.	Bid.	Asked.
Gas. Co.'s of N. Y. City.				
Harlem	$1,850,000	50	105	110
Manhattan	4,000,000	50	245	248
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	..	100	103
" Bonds	500.000	1000	100	103
Mutual	5,000,000	100	102	10½
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	135	137
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	182
Citizens	1,200,000	20	95	—
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	50	55
" Bonds	$ 325,000	...	---	95
" Scrip	300,000	...	85	--
Metropolitan	1,000,000	100	75	—
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	135	140
" Scrip		...	98	100
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	--	90
Baltimore, Md.	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	100	—
" " Ctfs.	53,000	—	--	—
" " Bds.	124,000	—	—	--
Derby of Conn.	160,000	100	60	80
East Boston, Mass.		25	132	---
Fort Wayne, Ind.		100	...	----
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	152	—
Hempstead, L.	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	125	135
Leoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	--	--
Peoples of Baltimore		25	99	100
" Bonds			106	---
Perth Amboy		25	---	95
Rochester, N. Y.		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	---	100
Stillwater, Minn.	50,000	50	—	26
Suburban, W'stch'str	390,000	50	---	100
Saugerties, N. Y.	15,000	100	110	115
Troy, Citizens	600,000	100	---	100
Central, Westchester	466,000	50		95

FOR SALE OR TO LEASE,
THE EXTENSIVE AND WELL KNOWN
Philadelphia Fire Brick
AND
Clay Retort Works,
on VINE STREET, west of TWENTY-THIRD STREET, extending to Schuylkill River, are now offered for Sale or to Lease.

These Works were established by the late John Neukumet, and are now in good running order. Immediate possession can be given.

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INSPECTORS OF
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A HALF INTEREST IN A SMALL GAS WORKS WILL be sold, or leased to a practical gas man. Two thousand feet of natural gas per day. Address
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Importing Tailor
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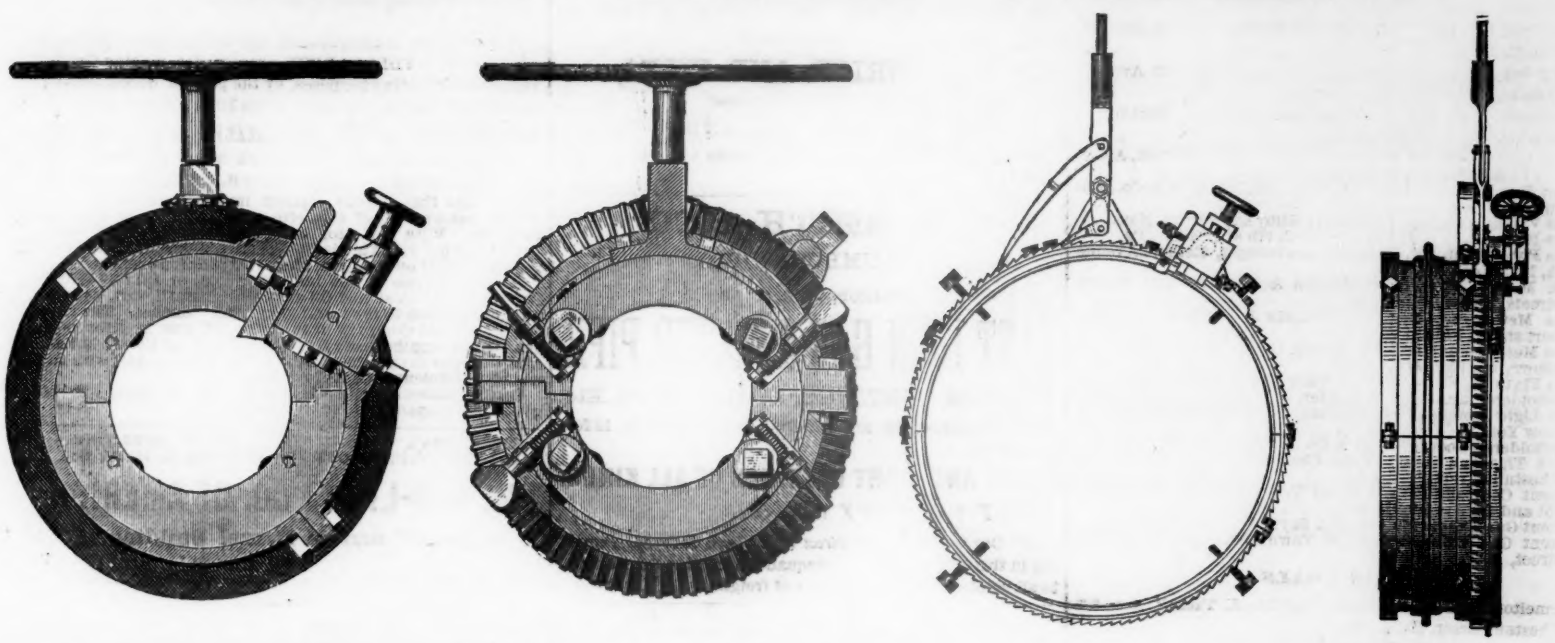
PATENTED MAY 23rd, 1876.

THIS IS THE ONLY HAND MACHINE IN THE WORLD FOR CUTTING

CAST IRON PIPE.



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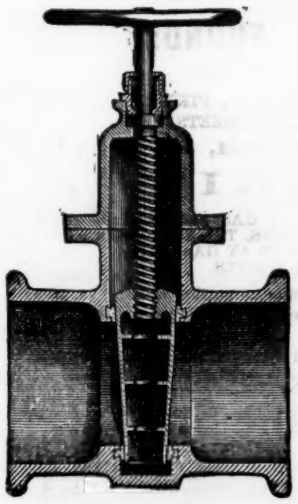

These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is NO LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.

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CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
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GAS AND WATER VALVES ½ INCH TO 36 INCHES DIAMETER.

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A. H. ALLEN, Secretary.
WM. J. VALENTINE, Treasurer.
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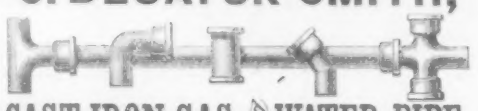

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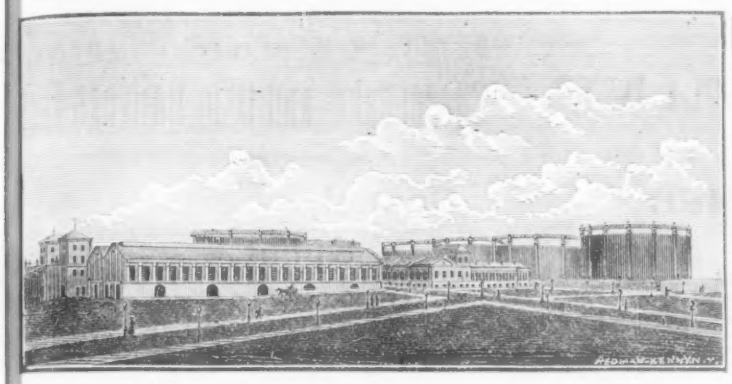

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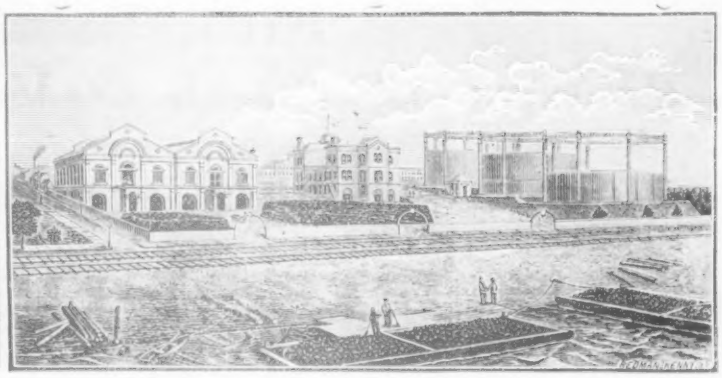

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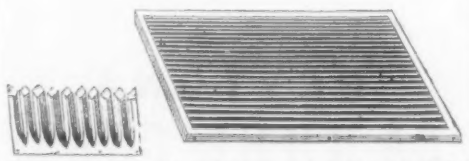

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294-1y n

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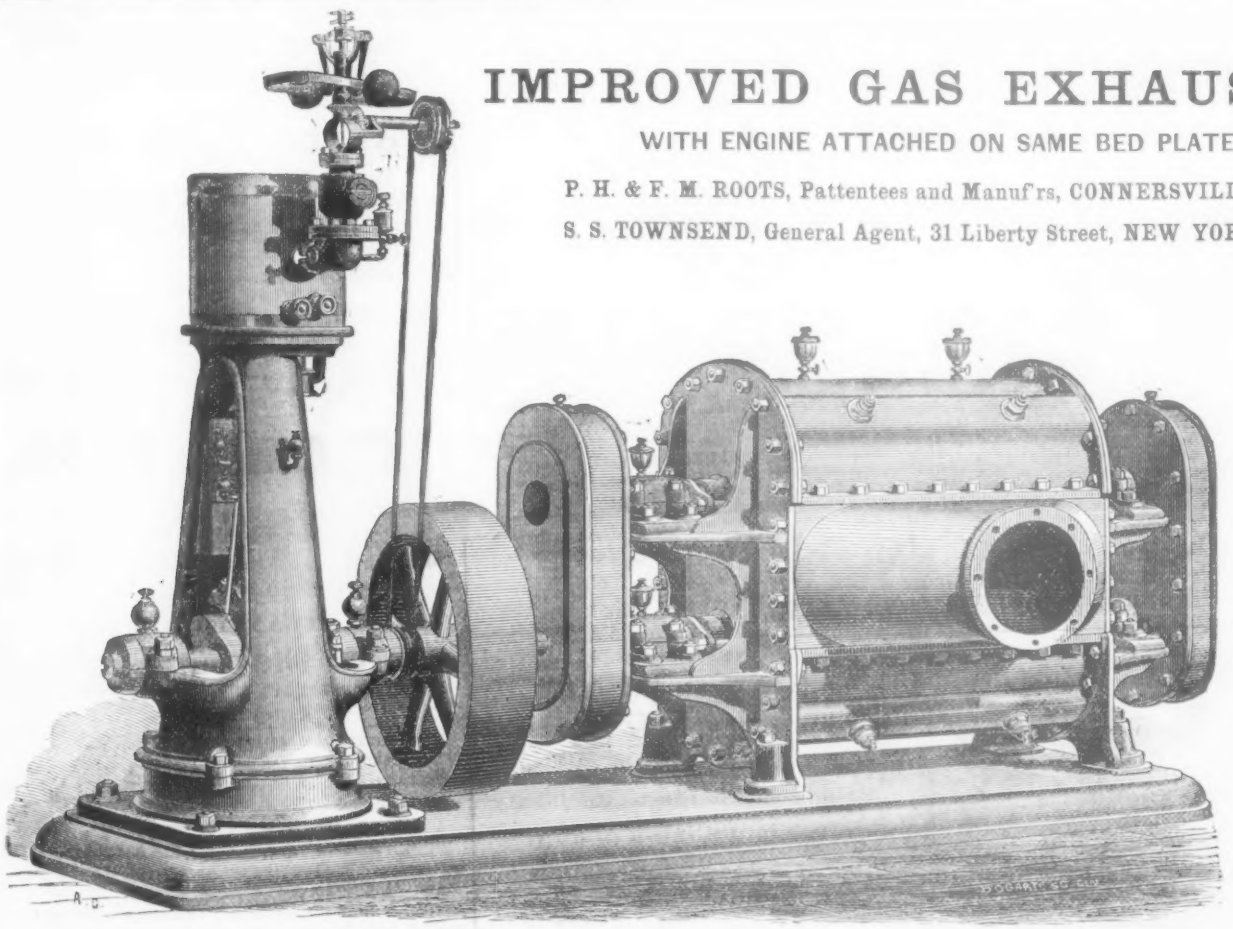

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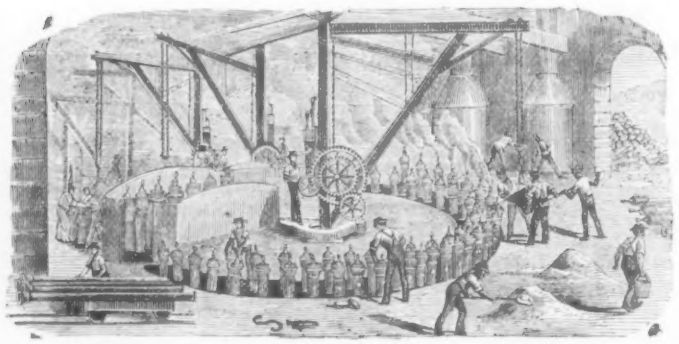

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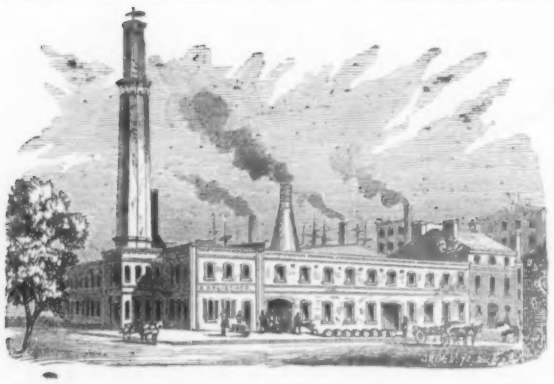

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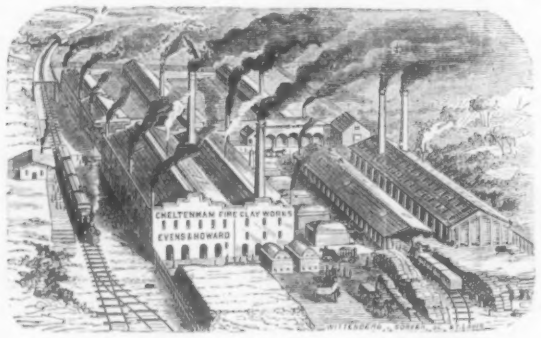

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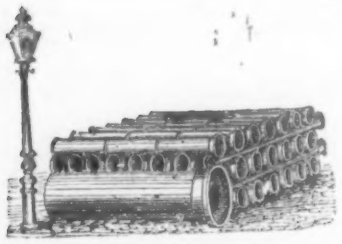

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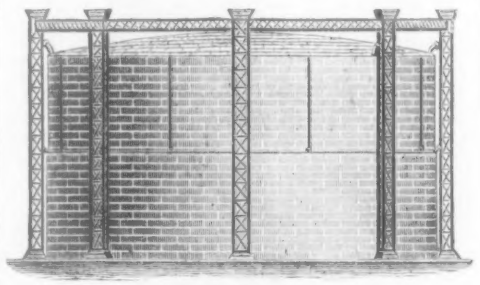

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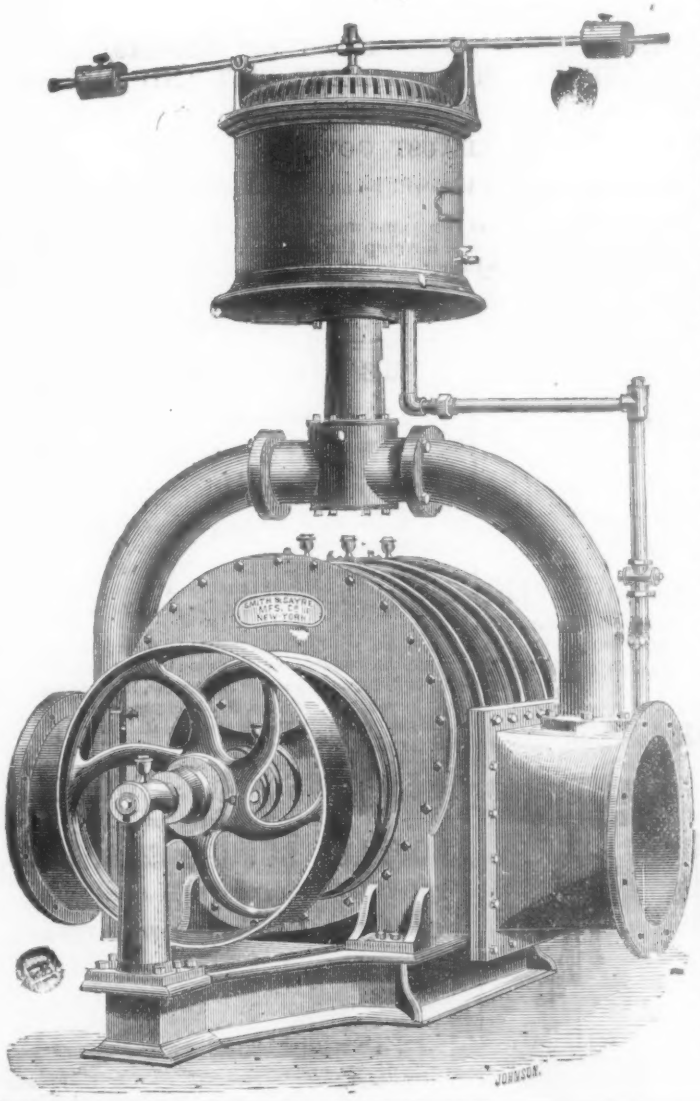

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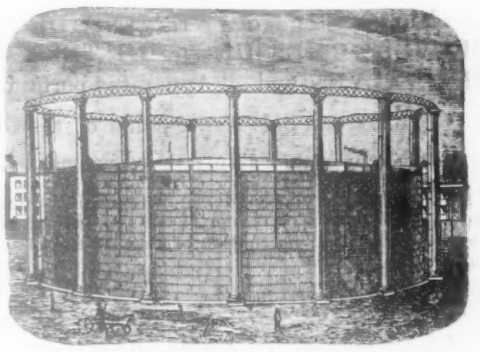

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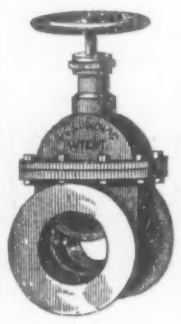

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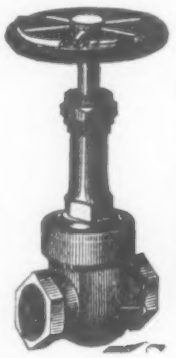

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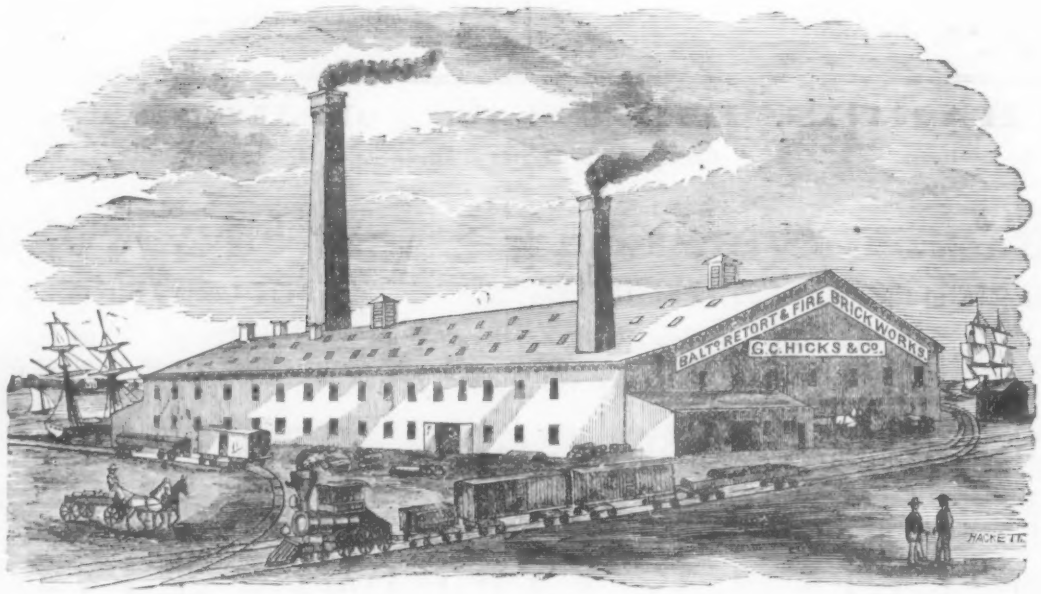

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"Yours truly, E. T. COX," *of the Centennial Jury of Awards.*